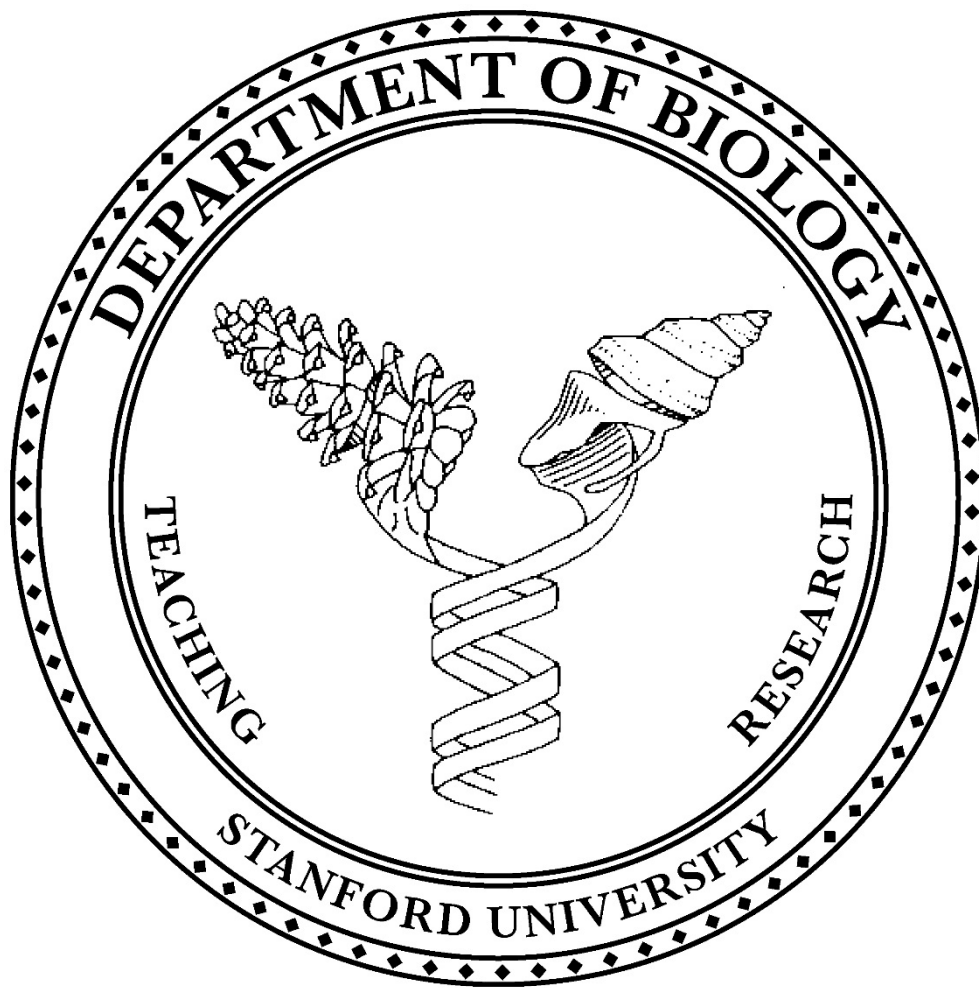


B.S. Handbook
2015 – 2016



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CONTACT INFORMATION

Stanford University

Department of Biology

Student Services Office

Gilbert Building, Room 108

Stanford, CA 94305-5020

Main Website: <http://biology.stanford.edu>

Honors Website: <http://biohonors.stanford.edu>

Facebook: Stanford Biology Undergraduate Student Services

LinkedIn: Stanford Biology (group)

Office hours: Monday - Friday 8:00am-12:00pm and 1:00-4:30pm (including summer quarter)

Faculty Advisors: <http://biology.stanford.edu/faculty> for pictures and research interests and http://biology.stanford.edu/sites/all/files/Faculty_Advisors.pdf for contact info and office locations.

Student Services Staff:

Carolynn Beer, Undergraduate Student Services Officer & Honors Program Coordinator

Phone: (650) 723-5060

Email: cbeer@stanford.edu

Dan King, Student Services Manager

Phone: (650) 723-5413

Email: dking20@stanford.edu

BioBridge Student Peer Advisors

biobridge@lists.stanford.edu

<http://biology.stanford.edu/biobridge/>

Office hours during Weeks 2-9 of Autumn, Winter, and Spring quarters -- Monday-Friday 1:00-4:30pm

Undergraduate Advising and Research (UAR):

For questions about general academic advising, pre-professional requirements, free tutoring, and learning skills courses. Drop-ins welcome.

Sweet Hall, 1st Floor

(650) 723-2426

<http://undergrad.stanford.edu>

DEPARTMENT OVERVIEW

An undergraduate degree in Biology serves as preparation for professional careers, including pre-health professions (including medicine, dentistry, and veterinary sciences), teaching, consulting, research, and field studies. Additionally, the major provides a valuable focus of a liberal arts education for those not planning careers in science-related fields. The department has several research facilities and resources, which are outlined in detail below.

Main Campus

The main Stanford campus is the hub for the Biology Department. Faculty members have labs in multiple buildings, including Gilbert, Herrin, Lokey/ChemBio, Clark, Y2E2, Carnegie Institution and Jasper Ridge Biological Preserve, and range in research from cells, genetics and biophysics to ecology, evolution and population studies. Students are encouraged to seek out research opportunities with any of the departmental faculty members in any of these locations. Students take the majority of their courses on campus and also participate in lab courses on campus.

Hopkins Marine Station - <http://hopkins.stanford.edu/>

Research and teaching at Hopkins Marine Station is extremely diverse, ranging from general issues in cellular developmental biology, neurobiology, comparative physiology, behavior, evolution, molecular genetics, population biology, biomechanics, conservation biology and ecology to more specific studies on the kelp forest adjacent to the station.

Hopkins Marine Station opened in 1892 as a marine biology teaching and research facility and operates as a branch of Stanford University's Department of Biology. The Station is located in Pacific Grove, on the southern shore of Monterey Bay. Ninety miles south of Palo Alto, it lies in a region of scenic beauty, enormous marine biodiversity and great historic interest.

The Station occupies an 11 acre exposed rocky headland known locally as China Point. The area immediately offshore is the Lovers Point State Marine Reserve (formerly known as the Hopkins Marine Life Refuge, and soon to be renamed the Julia B. Platt State Marine Reserve). This area was the first community-based marine reserve in California, and perhaps the whole United States, having been established in 1931. The waters and adjacent rocky intertidal regions support a rich and diverse population of marine life, and have been the focus on a century of research in marine biodiversity, cell biology, neurobiology and physiology.

The Station is staffed by a resident faculty of eleven biologists and a full time support staff of seven. It provides year round facilities for faculty, graduate students and postdoctoral scholars. The Miller Library houses an outstanding collection of marine literature and also offers full access to the University's electronic journal subscriptions. Approximately 20 introductory and advanced courses for undergraduates on various aspects of marine and general biology are offered during winter and spring terms of the academic year and during the summer session. Most courses have laboratory sections that exploit the potential of working with readily available marine plants and animals. Hopkins faculty also teach Ecology, Evolution and Plant Biology, which is the third course in the Bio Core sequence, along with a highly coordinated lab course, and a set of expeditionary courses to Hawaii, Baja Mexico and the Pacific Islands. The small class sizes forge close student-faculty interactions, and student research is encouraged and supported during the academic year or summer months. All of the courses numbered 100 or above are acceptable for credit toward major electives, with a few limitations as outlined in the *Stanford Bulletin*.

Additionally, several courses at Hopkins fulfill requirements for the Ecology/Evolution and Marine Biology fields of study as well as central menu areas within the general biology curriculum.

Jasper Ridge Biological Preserve

Jasper Ridge Biological Preserve (JRBP) is located near Stanford University's campus in the eastern foothills of the Santa Cruz Mountains. Set amidst a rapidly urbanizing area, the preserve provides a natural laboratory for researchers from all over the world, educational experiences to students and visitors, and refuge to native plants and animals. The Preserve encompasses remarkable geologic, topographic, and biotic diversity within its 481 hectares (1,189 acres). In recent years, 50 to 60 research projects have been active and approximately 2,000 Stanford undergraduates visit the preserve as part of field classes each year.

The area now included within JRBP has been used for scientific studies since the opening years of Stanford University. Since that time, the scientific contributions of JRBP have reflected the capacity of scientists and students at Stanford and other institutions to envision, conduct, and interpret groundbreaking research involving a range of academic disciplines. Many current studies draw on this legacy of research, while others address new questions and problems. More than 165 Ph.D. dissertations and undergraduate theses have involved research at JRBP, and since 1965, more than 350 publications have reported research at JRBP.

The preserve is widely recognized as the site of discoveries that have been important both to fundamental scientific questions and to society. For example, Professor Paul Ehrlich's discoveries about Bay checkerspot butterflies demonstrated the unique value of long-term research in ecology and helped foster federal programs to fund such studies. The importance of long-term research and monitoring is now widely accepted. A number of scientific publications resulting from research at JRBP discovered ecological patterns so significant they stimulated hundreds of related studies. Many of these papers by Professors Chris Field and Harold Mooney established principles that are fundamental to the largest research program now at JRBP, a study of ecosystem responses to global environmental changes. These studies and others demonstrate the intrinsic connection between JRBP's research and conservation missions. JRBP also contributes broadly in that it is open to any qualified investigator who proposes studies that are consistent with the preserve's mission of research, education, and long-term resource protection.

Stanford faculty involved in research at JRBP include Professors Rodolfo Dirzo, Paul Ehrlich, Scott Fendorf, Chris Field, David Freyberg, Tadashi Fukami, Deborah Gordon, Elizabeth Hadly, Harold Mooney, Gretchen Daily, Peter Vitousek and others. Stanford courses involving the preserve include BIO 44Y (Core Plant Biology & Eco Evo Laboratory), BIO 105A/B (JRBP Docent Training Program), BIO 117 (Biology and Global Change), CEE 166D (Water Resources), EARTHSYS 10 (Introduction to Earth Systems), EARTHSYS 189 (Field Studies in Earth Systems), GES 175 (Science of Soils), and many others.

For more information visit: <http://jrpb.stanford.edu/>. Research permit applications and educational use permit applications can be found on the web site.

Carnegie Institution of Washington

The Carnegie Institution, a private, nonprofit organization engaged in basic research and advanced education in biology, astronomy, and the earth sciences, was founded and endowed by Andrew Carnegie in 1902 and incorporated by an act of Congress in 1904. Andrew Carnegie conceived the institution's

purpose "to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind."

From its earliest years, the Carnegie Institution has been a pioneering research organization, devoted to fields of inquiry that its trustees and staff consider among the most significant in the development of science and scholarship. The institution is located on the main Stanford campus and includes the Department of Plant Biology (<http://dpb.carnegiescience.edu/>) and Department of Global Ecology (<http://dge.stanford.edu/>), both of which have Biology department faculty affiliates. The Plant Biology group has seminars most Fridays at 4pm; students are welcome to attend: <http://dpb.carnegiescience.edu/events>.

Falconer Biology Library

Falconer Biology Library is located on the third floor of Herrin Hall teaching wing. Digital materials, including a large collection of journal article databases, ejournals, ebooks, and digital theses are available through the library's website. The library provides quiet and inviting study space and a collection of periodicals, monographs, and reference works specifically emphasizing the life sciences. Biology course materials are on reserve here, and copies of Ph.D. theses are available. Library staff can answer questions or help students get started with literature research. Contact library staff at 723-1528 or falconerlibrary@stanford.edu for additional information or visit: <http://library.stanford.edu/falconer>.

ADVISING

Advising is available for all Biology majors. There are three departmental sources for advising:

1. Faculty Advising – all Biology majors are required to choose a faculty advisor in the department when they declare the major. Faculty advisors are available to discuss course load, future career and academic interests and research/honors. Students contact faculty directly via email or by visiting their offices. A list of office locations, office hours, phone numbers and email addresses can be found here: http://biology.stanford.edu/sites/all/files/Faculty_Advisors.pdf.
2. Staff Advising – The undergraduate student services officer in the Student Services Office is available to help students with administrative matters including, but not limited to, transferring course work, petitioning major requirements, reviewing course schedules, specific questions related to research, grants, and the departmental honors program, and advising about the general requirements and fields of study available in the degree program. All students have an academic file in the Student Services Office, and will receive a degree progress update via email two times per year from the undergraduate advisor. Staff advisors are located in Gilbert 108.
3. Peer Advising – BioBridge (<http://biology.stanford.edu/biobridge/>) is the department peer advising team. BioBridge is comprised of junior and senior biology majors. They are available to offer advice on course loads, choosing advisors and electives, as well as tips on finding a research advisor or sharing personal experiences about studying abroad or at Hopkins Marine Station. BioBridge can be reached via email at biobridge@lists.stanford.edu or during office hours in Gilbert 108.

In addition to these departmental resources, students are encouraged to seek advice from staff advisors in the Undergraduate Advising & Research Programs Office (UAR). The UAR has pre-professional advisors, and also provides assistance with planning specific years in the undergraduate career. Additionally, they are available to help students with academic difficulty. For more information, please see their website at: <http://undergrad.stanford.edu/>.

HONOR CODE and FUNDAMENTAL STANDARD

Honor Code - <https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard#honor-code>

The Honor Code is the university's statement on academic integrity written by students in 1921. It articulates university expectations of students and faculty in establishing and maintaining the highest standards in academic work:

- The Honor Code is an undertaking of the students, individually and collectively:
 - that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;
 - that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.
- The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.
- While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.

Examples of conduct that have been regarded as being in violation of the Honor Code include:

- Copying from another's examination paper or allowing another to copy from one's own paper
- Unpermitted collaboration
- Plagiarism
- Revising and resubmitting a quiz or exam for re-grading, without the instructor's knowledge and consent
- Giving or receiving unpermitted aid on a take-home examination
- Representing as one's own work the work of another
- Giving or receiving aid on an academic assignment under circumstances in which a reasonable person should have known that such aid was not permitted

Please see this website for further information on avoiding plagiarism:

<http://studentaffairs.stanford.edu/communitystandards/integrity/plagiarism>.

Fundamental Standard - <https://communitystandards.stanford.edu/student-conduct-process/honor-code-and-fundamental-standard#fundamental-standard>

The Fundamental Standard has set the standard of conduct for students at Stanford since 1896. It states: Students at Stanford are expected to show both within and without the university such respect for order, morality, personal honor and the rights of others as is demanded of good citizens. Failure to do this will be sufficient cause for removal from the University.

Explanations for both of the Honor Code and the Fundamental Stanford were taken from the website for the Office of Community Standards. For more information about the Honor Code and the Fundamental Standard, please visit: <https://communitystandards.stanford.edu/>.

DEGREE REQUIREMENTS

Like any other major on campus, the biology major has a specific set of requirements, which is in addition to General Education and University requirements. The major can be satisfied in any of the following ways:

- By following the general major requirements without honors
- By following the general major requirements with honors – course requirements are the same as those for the general major without honors, with the exception of BIO 44Y—BIO 44Y is not required for students completing the honors program.
- By following the requirements for one of our seven fields of study with honors (outlined below).

Course requirements for each field of study vary significantly from those of the general major.

In general, the major consists of a year-long BioCore sequence (three lecture courses and two lab courses), chemistry, math, physics, and upper-division electives. For a checklist of specific major requirements, please see Appendix B.

General Major

The general biology major is designed for students who would like a broad-based biology curriculum. The foundation courses for the general major include the Bio Core lectures and labs, chemistry, physics, and mathematics. Within the upper-division electives, students experience a breadth of courses by satisfying the Central Menu requirement: 1 course in 3 of the 4 Central Menu areas (Molecular, Cell/Developmental, Organismal and Ecology/Evolution). Beyond the Central Menu requirement, students can take their remaining upper-division electives from Biology (BIO) and Hopkins (BIOHOPK) course offerings, and also from the Approved Out-of-Department Elective list.

Students following the general biology major requirements have the option to also complete the departmental honors program, but are not required to do so.

For further information about the general major, see Appendix C or visit:

<http://biology.stanford.edu/requirements>.

Fields of Study

For students wishing to concentrate their studies in specific sub-disciplines of biology, seven different specialized fields of study are available:

1. Biochemistry and Biophysics
2. Computational Biology
3. Ecology and Evolution
4. Marine Biology
5. Microbes and Immunity
6. Molecular, Cellular and Developmental Biology
7. Neurobiology

Requirements for all seven fields of study are significantly different from each other and from the general major. Students who wish to complete a field of study will also be required to complete the departmental honors requirements, which are discussed below. For further information about the fields of study, see Appendices D-J or visit: <http://biology.stanford.edu/requirements>.

Writing in the Major

All undergraduate students are required to complete a course demonstrating proficiency in Writing in the Major. For the biology degree, these course options include:

- BIO 44Y – Core Plant Biology and Eco Evo Laboratory
- BIO 107 – Human Physiology Laboratory
- BIO 137 – Plant Genetics
- BIO 168 – Explorations in Stem Cell Biology
- BIO 196A – Biology Senior Reflection
- BIO 197WA – Senior Writing Project: The Personal Essay in Biology
- BIO 199W – Senior Honors Thesis: How to Effectively Write About Scientific Research
- BIOHOPK 44Y – Core Laboratory in Plant Biology, Ecology and Evolution
- BIOHOPK 172H – Marine Ecology: From Organisms to Ecosystems

PETITIONS

Students who wish to petition for exemptions or substitutions in their degree program must submit a General Petition form which is available in the Student Services Office or online at: http://biology.stanford.edu/sites/all/files/general_petition.pdf. This form must be filled out and signed by the faculty advisor, and students are required to attach a letter of justification, the syllabus for the course being petitioned, and a copy of their unofficial transcript. Students petitioning for the inclusion of a course that is not on the Approved out-of-department Elective list must be aware that courses are approved only if they are upper division courses with a substantial biological component. Departmental petitions are submitted to the Student Services Office. The petitions are forwarded to the Undergraduate Studies Committee for consideration and then returned to the Student Services Office; staff will notify the petitioning students of the Committee's decision. **NOTE: Always be sure to submit petitions before taking the course(s) in question.**

Petitions should be made as soon as the need for one is recognized. **Petitions requesting substitution or exemption from a degree requirement will not be accepted after the add/drop deadline two quarters prior to the conferral of a student's degree.** For example, a student who plans to graduate in Spring of their senior year must submit all petitions for substitution or exemption no later than the add/drop deadline for Autumn quarter of their senior year.

SENIOR REFLECTION

TSR is a highly personalized creative project centered on any aspect of biology that has particularly affected a student during his or her education. Each project must include a written component in which the student explains the ideas, background and process that gave rise to the project. Students are encouraged to explore and incorporate additional artistic or creative forms of expression into their final works.

Students are required to enroll in a three-quarter course series (BIO 196A/B/C). During the Autumn Quarter (BIO 196A), students bond, brainstorm, explore various media, and develop a proposal for a specific project. They also identify appropriate faculty mentors both within biology and in other departments to support their projects' creative components. In Winter Quarter (196B), students focus on the creative execution of their projects. In the Spring Quarter (196C), projects are polished and prepared for public exhibition.

For more specific information, see <http://web.stanford.edu/~suemcc/TSR/>.

DIRECTED READING and INDEPENDENT RESEARCH

Students may earn university credit for participating in approved faculty sponsored research projects by registering in any of the following courses:

- BIO or BIOHOPK 198 (Directed Reading)
- BIO 198X (Out-of-Department Directed Reading)
- BIO 199 (Advanced Research Laboratory in Experimental Biology)
- BIO 199X (Out-of-Department Advanced Research Laboratory in Experimental Biology)
- BIOHOPK 199H (Undergraduate Research)

Laboratory research work is an invaluable opportunity for gaining experience in research techniques and learning to make independent scientific contributions, and is a crucial element of the Honors Program in Biology.

BIO/BIOHOPK 198 may be taken as a prelude to research and may also involve participation in a laboratory or research group seminar and/or library research. Usually, students register for BIO/BIOHOPK 198 for one quarter only. Graded S/NC only. Credit for Out-of-Department Directed Reading (BIO 198X) requires departmental approval.

In order to receive credit for **BIO 199, 199X, or BIOHOPK 199H**, students are expected to be involved in planning and execution of experiments, interpretation of data and presentation of results, and evaluation of the research field as commensurate with their background and experience. Although the project may be suggested by the sponsor, the research must be substantially independent to qualify for BIO 199, 199X or BIOHOPK 199H. The research field must encompass biological concepts and processes.

Appropriate Research Projects: Projects should be empirical or theoretical biological research, consisting of *independent and original scientific work* by the student. Applied clinical, environmental, or technological studies may be appropriate in cases where there is a *major* analytical, experimental or observational component to the study, involving independent conceptual, field or laboratory work by the student. Simply collecting data or samples from human subjects or interviewees, collating data, doing repetitive technical work, or doing statistical analyses is not sufficient for research credit. Students should discuss the nature of their projects with their research advisors and/or faculty advisors prior to petitioning for approval, if there is any doubt about appropriateness.

Out-of-Department Directed Reading and Research: If the research sponsor is *not* a faculty member in the Department of Biology (e.g. faculty in the medical school), students must submit a petition to the Student Services Office for evaluation before enrolling in BIO 198X or 199X. This is only available to officially-declared biology majors. Petitions and detailed instructions are available on the Biology Research and Honors web site at <https://biology.stanford.edu/research>.

Exploring Research Options: Students interested in research but having trouble deciding where to start, should consider:

- enrolling in BIO 3 (Frontiers in Marine Biology) during Autumn Quarter.
- attending the weekly Departmental Seminar on Mondays at 4:00pm in Herrin T-175.

- attending the weekly Carnegie Institution Plant Biology Seminar on Fridays at 4:00pm at Carnegie.
- attending the Spring Quarter Department of Biology Achauer Undergraduate Honors Symposium.
- attending the annual PumpkinFest celebration. While it is fun in nature, it is a great way for students to meet faculty, postdoctoral scholars, graduate students and each other.

Students interested in a particular faculty member's research area are encouraged to familiarize themselves with their work by reading publications prepared by that laboratory group. Most faculty members can provide students with publication reprints upon request. Research positions are available and, with persistence and determination, any student can secure one.

DEPARTMENTAL HONORS PROGRAM

The following is a brief summary of the Honors Program. Students following the general major have the option of completing the Honors Program. All students pursuing a Field of Study are required to complete the Honors Program. More detailed information is available from the Biology Research and Honors web site at <https://biology.stanford.edu/honors>.

To graduate with departmental honors, a student must conduct an independent research project typically over the course of at least one year; projects are started no later than Autumn or Winter quarter of the junior year. Research must be done in a Biology Department lab or a lab in an outside department for which the student has obtained prior approval.

Administrative steps include:

- A faculty-approved Departmental Honors Proposal form, including a written research proposal describing the honors project.
- Completion of at least 10 units of BIO 199, 199X or BIOHOPK 199H research in the same laboratory.
- Online submission of an approved Honors Thesis
- A poster describing the research project or an oral presentation at the annual Spring Quarter Achauer Undergraduate Honors Symposium.
- A 3.0 grade point average in departmentally required coursework (Note: BIO 196A/B/C, 197WA, 198, 198X, 199, 199W, 199X, 290, 291, BIOHOPK 198H and 199H grades are not computed into this GPA).

The Honors Research Proposal

A written proposal must accompany the Honors Proposal form and should include a 5-6 page paper that includes the objective of the research, background information, materials and methods, preliminary and/or anticipated results, and references. Both the research sponsor and a second reader must sign this proposal. The second reader should have some expertise in the research field and **MUST** be a member of the Department of Biology if the research sponsor is not. Additionally, students are required to submit their Biology major GPA printout as part of this process; a GPA calculator is available at http://web.stanford.edu/dept/biology/biohonors/info/gpa_calculator.html. Additional information about the honors research proposal can be found at https://biology.stanford.edu/sites/all/files/honors_proposal.pdf.

The Honors Thesis

The Honors Thesis should take the form of a scientific paper to be submitted for journal publication. Students can receive writing help from many sources, three of which are listed below:

- Hume Center for Writing and Speaking - <https://undergrad.stanford.edu/tutoring-support/hume-center>
- PWR 193 (Writing the Honors Thesis) – offered in Winter and Spring quarters, this course is a review of key elements of thesis process, including literature reviews, structure, argumentation, style and documentation. Group and individual workshops are included.
- BIO 199W (Senior Honors Thesis: How to Effectively Write About Scientific Research) which is offered in Winter Quarter and intended for graduating seniors.

A rough draft **must** be submitted to the research sponsor and second reader at least two to three weeks before the final thesis deadline. Readers must be members of the Academic Council (this is noted under their name in a Stanford-only view in StanfordWho). This review process assures that the thesis will be approved in time for graduation. In order to be considered for a University Firestone Award for Superior Undergraduate Research, the research sponsor must nominate the student by the deadline and the student must submit as close to a final draft as possible in late April. Submit the thesis online via SDR, along with a hard copy of the signed signature page to the Student Services Office (Gilbert 108) by the appropriate deadline.

The Honors Symposium

All Honors Program students graduating Spring Quarter are required to either present a 10-minute talk or display a poster during the Honors Symposium in late May. Students planning to graduate with honors during a quarter other than spring are required to submit a poster in the quarter in which they graduate for display later at the Honors Symposium in Spring.

TRANSFER STUDENTS and TRANSFER CREDIT

Because of the differences between Stanford undergraduate courses and prerequisites and those of many other institutions, transfer students may face problems not encountered by entering freshmen. Transfer students are strongly urged to visit the Student Services Office in Gilbert 108 during New Student Orientation to get course credit evaluations. Course catalogs, syllabi, and/or lecture notes from the former institution(s) are necessary in the evaluation and accreditation process. Transfer students are encouraged to find a faculty advisor soon after arrival.

All transfer courses intended to fulfill department requirements *must* be evaluated on Transfer Credit Evaluation forms which are available in the Student Services Office or online at http://biology.stanford.edu/sites/all/files/transfer_eval.pdf. **This is a departmental procedure that is separate from the Registrar's Office Transfer Credit Evaluation procedure.** Be sure to review the Registrar's Office website for complete instructions on their process: <http://studentaffairs.stanford.edu/registrar/students/transfer-credit>.

The department authorizes transfer credit only for courses whose content parallels Stanford courses and have comparable prerequisites (not merely a comparable course title). To substitute a course taken elsewhere for an upper-division Stanford course, course content must be primarily in biology and related sciences (not in policy or public health) and approved by a department faculty member teaching in the area of the course. One would only be able to receive credit by meeting the same criteria as outlined above. Students must provide exams, reading lists, term papers and other materials for the evaluation if no course description or syllabus is available.

To have transfer work from another institution evaluated for major requirements, students must fill out a Transfer Credit Evaluation form, provide a course syllabus and catalog description (textbook titles, final exams, and course notes may also be required in certain cases). Transfer Credit Evaluation forms must be signed by faculty members who are authorized to evaluate coursework in the areas listed. The authorized faculty are listed on the form: http://biology.stanford.edu/sites/all/files/transfer_eval.pdf - to complete the departmental process, **return the completed evaluation form(s) to the Student Services Office** in Gilbert 108. These forms are kept in each student's department academic file.

NOTE: All current Stanford students should have potential transfer courses evaluated before enrolling in them.

Overseas Studies

Detailed information about Stanford's Overseas Studies Program can be found in the Overseas Studies Program office, located on the ground level of Sweet Hall or at <https://undergrad.stanford.edu/programs/bosp>.

For Biology majors, the ideal time to attend an overseas campus is summer through winter (end of sophomore year, beginning of junior year). Courses in many Bing Overseas Studies Programs are already pre-approved to count toward the major elective requirement. While Australia and Oxford tend to be the most popular choices for biology majors because of their science course offerings, many students also participate in programs abroad that contain no science courses.

Generally speaking, participating in the Overseas Studies Program requires very careful academic planning, but it is well worth the effort. Students are advised to meet with the Undergraduate Student Services Officer before going abroad to ensure that their course plans are realistic. At a minimum, students should plan on completing the Bio Core lecture and lab series as well as calculus and some chemistry before attending an overseas campus.

COTERMINAL M.S. PROGRAM

The coterminal program admits Stanford undergraduates into the M.S. degree program, which they complete concurrently with their B.S.

Any Stanford undergraduate is eligible to apply. Students must fulfill a specific set of prerequisites, which include the biology core lectures and labs, chemistry, physics and calculus as outlined in the preparation of the undergraduate Biology major. Additionally, students must have completed 120 units toward graduation (UTG) by the end of the quarter immediately preceding their proposed admission quarter. This unit total includes Advanced Placement (AP) and transfer credit. The prerequisite requirements need not be completed before applying to (or entering) the Coterminal Master's Degree Program, but must be completed at the time of the M.S. degree conferral.

More specific information about the Coterminal M.S. program and admissions procedures can be found on the department website at <http://biology.stanford.edu/coterminal-master-science>.

GRADUATION

The Student Services Office staff are responsible for certifying completion of departmental requirements for graduation. All biology majors will receive degree progress e-mails three times per year. However, if

students are unsure about their status, they are encouraged to request an update from the Undergraduate Student Services Officer in the Student Services Office at any time.

All students should apply to graduate on AXESS by the Registrar's deadlines; <http://studentaffairs.stanford.edu/registrar/academic-calendar>. There is a late fee assessed for missing this deadline. Students can withdraw their application to graduate at any time with no penalty fee.

Graduation with Distinction

Each Spring Quarter, the Registrar's Office nominates students whose grade-point average is in the top 15% of the overall senior class to graduate with distinction. Students cannot apply for this designation.

Commencement Awards

Several awards are available from the department to honor outstanding graduating students. Nominations for these awards are solicited from faculty members in the department; students cannot apply for these awards. The nominations are submitted by department faculty members and reviewed by the Undergraduate Studies Committee; their selections are announced at the department's commencement ceremony. Currently, the department offers the following awards:

The Stephen Fox Award honors the most outstanding graduating senior in the Department of Biology who has excelled broadly in the areas of scholarship, research and service.

The Norman K. Wessells Award is presented annually to the most outstanding graduate or undergraduate course assistant in the Department of Biology.

The Lauren D. Weinstein Award is presented annually to an outstanding undergraduate course assistant who exhibits the dedication to life and to science education exemplified by Lauren Weinstein, Class of '88.

Excellence in Teaching Awards are presented to TAs and CAs who have made exceptional contributions to courses offered in the Department of Biology.

Angela Lee Riepel Undergraduate Research Award is presented annually to an outstanding undergraduate student completing honors in biology. Beginning in 2012, this was awarded for the best poster presenter at the Achauer Undergraduate Honors Symposium. This award was created in honor of Dr. Angela Lee Riepel who was one of the undergraduate honors and research coordinators in the Department of Biology.

POST-GRADUATION PLANS

Pre-Health Professions

Biology majors who plan to enter dental, medical, nursing, optometry, pharmacy, physical therapy, or veterinary school must coordinate degree requirements with pre-professional training needs. Pre-Health Profession students usually have two advisors, one for the major and one for pre-professional plans. Pre-professional advisors are available through Undergraduate Advising & Research Programs (UAR) in Sweet Hall. Be sure to consult with a pre-professional advisor for information on course requirements for specific schools, completing application forms, required entrance examinations, surveys on previous accepted students, seminars, etc.

Graduate School

Faculty members can provide personal views on the pros and cons of graduate education (Ph.D. and/or M.S.). They can also tell students which schools are doing the most outstanding work in specific fields. The Peterson's Guide to Graduate Study in Biology (available online at <http://www.petersons.com>) is also helpful. Additionally, the BioBridge Peer Mentors hold workshops throughout the year related to topics of interest within the Biology community. Students interested in Pre-Grad Information Sessions should contact BioBridge at biobridge@lists.stanford.edu.

For those interested in graduate school, the Undergraduate Advising & Research Office in Sweet Hall maintains a library of graduate school catalogs and announcements of graduate program opportunities. Information about the MCAT, LSAT and GRE registration is available there as well. Additionally, the Career Development Center is an excellent resource for assisting students with updating their resumes for graduate school. See below for more detailed information.

Acquire graduate application materials no later than during the summer before senior year. Deadlines may be as early as November 1 (particularly when applying for financial aid), so students should plan on taking the GRE no later than October if applying to graduate school, and the MCAT no later than August if applying to medical school. Assistance with writing personal statements is available from the Undergraduate Advising and Research Programs Office in Sweet Hall.

Students with superior academic records may wish to apply for the NSF and/or other pre-doctoral graduate fellowships in the Fall Quarter. As a recipient of one of these awards, students receive a generous stipend and tuition allotment for 1-3 years of graduate study.

NOTE: Students pursuing a coterminal M.S./M.A. degree at Stanford should be aware that, if applying for an NSF, they should do so either 1) during the first year of graduate school or 2) prior to completing the fall term of the second year of graduate school.

Employment

For students interested in employment options, updating their resume for upcoming medical school applications, or finding out what to do in the gap year(s) prior to more schooling, the Career Development Center (CDC) is the place to go. Register with the CDC at <http://studentaffairs.stanford.edu/cdc/jobs-internships>. The CDC has the following services which can all be of benefit to students majoring in biology:

1. The Career Community Team offers **individual confidential appointments** with experienced career counselors to help with students' unique, career-related goals and concerns as well as for resume and cover letter reviews. The team also offers **meetups** on various career topics. Appointment and meetup schedules can be viewed through your Cardinal Careers account. In addition, the CDC provides a variety of career-related resources that include directories and handouts, as well as the Stanford Alumni Mentoring program, <https://mentoring.stanford.edu/>.
2. Cardinal Careers offers ways for students to connect with employers. Once a student has set up an account with the CDC, they have access to the **Cardinal Careers Job/Internship database**. The database enables students to use a variety of criteria to locate all kinds of jobs and internships. This system contains profiles on thousands of positions from companies and organizations interested in Stanford students and alumni. The **Cardinal Recruiting** program provides an opportunity for students to interview on campus with employers during Autumn and Winter quarters. During the Autumn Quarter, many interviews are for full-time jobs for graduating students. During the Winter Quarter, many of the interviews are for internships and other summer positions. Additional

information can be found at <http://studentaffairs.stanford.edu/cdc/employer/cardinal-recruiting>. The CDC also sponsors **Career Fairs** designed to provide students with general career and internship information through interactions with representatives from various organizations. A complete list of fairs can be found at: <https://studentaffairs.stanford.edu/cdc/jobs/jobsearch-career-fairs>.

BIOLOGY E-MAIL LISTS

All declared biology majors are automatically added to our biougrads@lists.stanford.edu. Staff and faculty in the department send out announcements, reminders, and other helpful information. Declared Biology majors that do not appear to be receiving any e-mail from the department's undergraduate mailing list should inform Student Services Officer so they can be added.

Students wishing to subscribe to any of the following e-mail lists for general announcements, can do so by going to <https://mailman.stanford.edu/mailman/listinfo/<listname>>. For example, to be added to the bio-all list, go to <https://mailman.stanford.edu/mailman/listinfo/bio-all> and follow the instructions on that page.

- **bio-all:** Used for general departmental announcements. Because it is a self-subscription list, be aware that not all faculty, grad students or staff are on bio-all.
- **bio-seminars:** an open list meant to be used for electronic communications regarding seminars of potential interest to students, faculty, researchers, employees and other members of the Department of Biology.

These are open and public lists meant to be used for electronic communications. Normal network etiquette should be observed (e.g., no advertisements, no chain letters, etc.).

APPENDICES

APPENDIX A – Central Menu & Elective Courses

APPENDIX B – Approved Out-of-Department Electives

APPENDIX C – General Major Requirements

APPENDIX D – Field of Study in Biochemistry and Biophysics

APPENDIX E – Field of Study in Computational Biology

APPENDIX F – Field of Study in Ecology and Evolution

APPENDIX G – Field of Study in Marine Biology

APPENDIX H – Field of Study in Microbes and Immunity

APPENDIX I – Field of Study in Molecular and Cell Biology

APPENDIX J – Field of Study in Neurobiology

The Department of Biology elective requirement for the general major must include a total of 24 elective units. Of those 24 elective units, students must complete one course from at least three of the four central menu areas listed below.

The purpose of the Central Menu is to expose students to the wide range of topics studied within the field of biology and is intended to give students a breadth of knowledge. Please note – this requirement is only for the general major. Students pursuing a specialized field of study should consult their requirement checklist for details on required elective courses.

AREA I – MOLECULAR

- BIO 104 – Advanced Molecular Biology
- BIO 110 – DNA Replication and Genomic Maintenance
- BIO 113 – Fundamentals of Molecular Evolution
- BIO 118 – Genetic Analysis of Biological Processes
- BIO 123A – Cell and Developmental Biology I
- BIO 123B – Cell and Developmental Biology II
- BIO 173 – Chemical Biology
- BIO 188/CHEMENG 181/281/CHEM 181 – Biochemistry I
- BIO 189/CHEMENG 183/283/CHEM 183 – Biochemistry II
- BIO 230 – Molecular and Cellular Immunology
- BIOHOPK 155H – Developmental Biology and Evolution
- BIOHOPK 160H – Developmental Biology in the Ocean
- CBIO 101/PATH 101 – Cancer Biology
- CEE 274A/CHEMENG 174/274 – Environmental Microbiology I

AREA III – ORGANISMAL

- BIO 112/HUMBIO 133 – Human Physiology
- BIO 153/PSYCH 120 – Cellular Neuroscience
- BIO 154 – Molecular & Cellular Neurobiology **
- BIO 158 – Developmental Neurobiology **
- BIO 163/HUMBIO 163 – Neural Systems & Behavior
- BIOHOPK 150H – Ecomechanics
- BIOHOPK 154H – Animal Diversity (invertebrate zoology)
- BIOHOPK 161H – Invertebrate Zoology
- BIOHOPK 162H – Comparative Animal Physiology *
- BIOHOPK 167H – Nerve, Muscle and Synapse
- BIOHOPK 168H – Disease Ecology
- BIOHOPK 179H – Physiological Ecology Marine Megafauna**
- BIOHOPK 187H – Sensory Ecology
- MI 185 – Topics in Microbiology

AREA II – CELL/DEVELOPMENTAL

- BIO 118 – Genetic Analysis of Biological Processes
- BIO 123A – Cell and Developmental Biology I
- BIO 123B – Cell and Developmental Biology II
- BIO 129B – Cellular Dynamics II: Building a Cell
- BIO 137 - Plant Genetics
- BIO 154 – Molecular & Cellular Neurobiology **
- BIO 158 – Developmental Neurobiology **
- BIO 173 – Chemical Biology
- BIO 230 – Molecular and Cellular Immunology
- BIOHOPK 155H – Developmental Biology and Evolution
- BIOHOPK 160H – Developmental Biology in the Ocean
- BIOHOPK 167H – Nerve, Muscle and Synapse
- BIOHOPK 187H – Sensory Ecology
- CBIO 101/PATH 101 – Cancer Biology
- CEE 274A/CHEMENG 174/274 – Environmental Microbiology I

AREA IV – ECOLOGY & EVOLUTION

- BIO 101 – Ecology
- BIO 113 – Fundamentals of Molecular Evolution
- BIO 121 – Biogeography
- BIO 136 – Evolutionary Paleobiology
- BIO 143 – Evolution
- BIO 144/HUMBIO 112 – Conservation Biology
- BIO 145 – Behavioral Ecology **
- BIO 182 – Modeling Cultural Evolution *
- BIOHOPK 150H – Ecomechanics
- BIOHOPK 163H – Oceanic Biology
- BIOHOPK 168H – Disease Ecology
- BIOHOPK 172H – Marine Ecology
- BIOHOPK 173H – Marine Conservation Biology
- BIOHOPK 177H – Dynamics and Management of Marine Pops
- BIOHOPK 179H – Physiological Ecology Marine Megafauna**
- BIOHOPK 185H – Ecology & Conservation of Kelp Forest
- CEE 274A/CHEMENG 174/274 – Environmental Microbiology I

2015-2016 Course Schedule (Areas shown in parentheses)

<u>Autumn</u>	<u>Winter</u>	<u>Spring</u>	<u>Not Offered 2015-16</u>	<u>Discontinued</u>
BIO 101 (IV)	BIO 104 (I)	BIO 110 (I)	BIO 121 (IV)	BIO 129A (I or II)
BIO 123A (I or II)	BIO 112 (III)	BIO 118 (I or II)	BIO 136 (IV)	BIO 160A (I or II)
BIO 188 (I)	BIO 113 (I or IV)	BIO 137 (II)	BIO 153 (III)	BIO 160B (I or II)
BIO 230 (I or II)	BIO 123B (I or II)	BIO 144 (IV)	BIO 154 (II or III)	BIO 171 (II)
CEE 274A (I, II or IV)	BIO 143 (IV)	BIO 145 (IV)	BIO 158 (II or III)	
	BIO 189 (I)	BIO 173 (I or II)	BIO 163 (III)	
<u>Summer</u>	BIOHOPK 155H (I or II)	BIOHOPK 150H (III or IV)	BIO 182 (IV)	
BIOHOPK 185H (IV)	BIOHOPK 161H (III)	BIOHOPK 154H (III)	BIOHOPK 160H (I or II)	
	BIOHOPK 163H (IV)	BIOHOPK 162H (III)	CBIO 101 (I or II)	
	BIOHOPK 172H (IV)	BIOHOPK 167H (III)	MI 185 (III)	
	BIOHOPK 177H (IV)	BIOHOPK 168H (III or IV)		
	BIOHOPK 179H (III or IV)	BIOHOPK 173H (IV)		
		BIOHOPK 187H (II or III)		

*alternate year course, offered odd-even years, e.g. 2015-16

**alternate year course, offered even-odd years, e.g. 2016-17

Biology MS students and undergraduate majors may apply the following out-of-department courses toward their elective unit requirements. Biology minors may apply these courses toward the minor provided the course has been approved for at least 3 units toward biology. These are advanced content courses; generally, they require the Bio core, math, chemistry or physics as prerequisites.

Not all courses have been approved for the maximum course units offered. Maximum course units and approved Biology unit values appear in parentheses below, i.e., (maximum/approved).

Since these courses are given in other departments, course availability and schedule is subject to change without notice. Students should check ExploreCourses (<http://explorecourses.stanford.edu/>) to verify offerings or contact the sponsoring department for additional details. Please check the prerequisites for each course, as these may vary.

Out-of-department courses taken for Biology elective credit must appear on this list or be approved by petition. Students should enroll in the BIO section of cross listed courses whenever possible. If you took a course which appears on a previous list or has since been discontinued by its sponsoring department, the units can still apply towards your elective requirement if you took it during the year in which the list included it.

MS Students: There are a few courses under the 100-level that are on this list – these are not allowable for graduate students per university policy. You must take courses designated primarily for graduate students. If the course you are interested in has an offering at the 100- and 200- levels, be sure to enroll in the 200-level section.

Anthropology (ANTHRO)

- 6 Human Origins (also 206; same as HUMBIO 6) (5/5) graduate students cannot enroll in ANTHRO or HUMBIO 6; courses below 100 cannot count toward degree requirements.
- 177 Environmental Change and Emerging Infectious Diseases (also 277; same as HUMBIO 114) (5/3)
- 363 Demography and Life History Theory (formerly 155) (5/5)

Applied Physics (APPPHYS)

- 236 Biology by the Numbers (same as BIOC 236) (3/3)

Biochemistry (BIOC)

- 158 Genomics, Bioinformatics and Medicine (also 258; same as HUMBIO 158G, BIOMEDIN 258) (3/3)
- 218 Computational Molecular Biology (same as BIOMEDIN 231) (3/3)
- 236 Biology by the Numbers (same as APPPHYS 236) (3/3)
- 241 Biological Macromolecules (same as BIOPHYS 241, SBIO 241) (5/5)

Bioengineering (BIOE)

- 214 Representations & Algorithms for Computational Molecular Biology (same as BIOMEDIN/GENE 214, CS 274) (4/4)
- 220 Introduction to Imaging & Image-Based Neuro Anatomy (same as RAD 220) (3/3)
- 280 Skeletal Developmental and Evolution (same as ME 280) (3/3)
- 450 Advances in Biotechnology (Same as CHEMENG 450) (3/3) **may only count toward the Biology requirements once.

Biomedical Informatics (BIOMEDIN)

- 210 Modeling Biomedical Systems: Ontology, Terminology, Problem Solving (same as CS 270) (3/3)
- 214 Representations and Algorithms for Computational Molecular Biology (same as BIOE/GENE 214, CS 274) (4/4)

- 231 Computational Molecular Biology (same as BIOC 218) (3/3)
- 258 Genomics, Bioinformatics and Medicine (same as BIOC 158/258, HUMBIO 158G) (3/3)
- 374 Algorithms in Biology (same as CS 374) (3/3)

Biophysics (BIOPHYS)

- 228 Computational Structural Biology (same as SBIO 228) (3/3)
- 241 Biological Macromolecules (same as BIOC 241, SBIO 241) (5/5)
- 250 Seminar in Biophysics (1/1)

Cancer Biology (CBIO)

- 101 Cancer Biology (same as PATH 101) (4/4)
- 241 Molecular, Cellular and Genetic Basis of Cancer (4/4)
- 275 Tumor Immunology (same as IMMUNOL 275) (3/3)

Chemical Engineering (CHEMENG)

- 174 Environmental Microbiology I (also 274; same as CEE 274A) (3/3)
- 450 Advances in Biotechnology (3/3) **may only count toward the Biology requirements **once**.
- 456 Metabolic Biochemistry of Microorganisms (same as CEE 274B) (3/3)

Chemistry (CHEM)

- 184 Biological Chemistry Laboratory (4/4)
- 185 Biochemistry III (3/3)

Civil & Environmental Engineering (CEE)

- 177 Aquatic Chemistry & Biology (4/4)
- 274A Environmental Microbiology I (same as CHEMENG 174/274) (3/3)
- 274B Metabolic Biochemistry of Microorganisms (same as CHEMENG 456) (3/3)
- 274D Pathogens & Disinfection (3/3)
- 278B Atmospheric Aerosols (3/3)

Computer Science (CS)

- 270 Modeling Biomedical Systems: Ontology, Terminology, Problem Solving (same as BIOMEDIN 210) (3/3)
- 274 Representations and Algorithms for Computational Molecular Biology (same as BIOE/BIOMEDIN/GENE 214) (4/4)
- 374 Algorithms in Biology (same as BIOMEDIN 374) (3/3)

Developmental Biology (DBIO)

- 201 Development and Disease Mechanisms (4/4)
- 210 Developmental Biology (4/4)
- 257 The Biology of Stem Cells (same as HUMBIO 157) (3/3)

Earth Systems (EARTHSYS)

- 122 Paleobiology (same as GS 123) (4/4)
- 128 Evolutionary History of Terrestrial Ecosystems (same as GS 128/228) (4/4)
- 134 Stable Isotopes in Biogeochemistry (same as EARTHSYS 234) (3/3)
- 144 Fundamentals of Geographic Information Science (GIS) (same as ESS 164) (4/4)
- 158 Geomicrobiology (same as EARTHSYS 258) (3/3)
- 176 Peninsula Open Space Trust Practicum: Community-Based Research for Open Space Management (3/3)

Energy (ENERGY)

- 240 Geostatistics for Spatial Phenomena (same as GS 240) (3/3)

Earth System Science (ESS)

164 Fundamentals of Geographic Information Science (GIS) (same as EARTHSYS 144) (4/4)

Genetics (GENE)

202 Human Genetics (4/4)

214 Representations and Algorithms for Computational Molecular Biology (same as BIOE/BIOMEDIN 214, CS 274) (4/4)

Geological Sciences (GS)

123 Paleobiology (same as EARTHSYS 122) (4/4)

128 Evolutionary History of Terrestrial Ecosystems (same as GES 228, EARTHSYS 128) (4/4)

240 Geostatistics for Spatial Phenomena (same as ENERGY 240) (3/3)

Human Biology (HUMBIO)

114 Environmental Change & Emerging Infectious Disease (same as ANTHRO 177/277) (5/3)

135 Exercise Physiology (4/4)

154C Cancer Epidemiology (4/4)

155B The Vaccine Revolution (same as MI 115B) (6/2)

155H Humans and Viruses I (same as MI 155H) (6/3)

157 The Biology of Stem Cells (same as DBIO 257) (3/3)

158G Genomics, Bioinformatics and Medicine (same as BIOC 158/258, BIOMEDIN 258) (4/4)

Immunology (IMMUNOL)

201 Advanced Immunology I (same as MI 211) (3/3) only appropriate for graduate students

202 Advanced Immunology II (same as MCP 202) (3/3) only appropriate for graduate students

204 Innate Immunology (same as MI 104/204) (3/3)

275 Tumor Immunology (same as CBIO 275) (3/3)

Mechanical Engineering (ME)

280 Skeletal Developmental and Evolution (same as BIOE 280) (3/3)

Microbiology and Immunology (MI)

104 Innate Immunology (also 204; same as IMMUNOL 204) (3/3)

115B The Vaccine Revolution (same as HUMBIO 155B) (6/2)

116 The Human Virosphere (also 216) (5/5)

155H Humans and Viruses I (same as HUMBIO 155H) (6/3)

155V Humans and Viruses II (6/3)

185 Topics in Microbiology (also 285) (3/3)

211 Advanced Immunology I (same as IMMUNOL 201) (3/3) **only appropriate for graduate students

Molecular and Cellular Physiology (MCP)

126 Neurons and Disease (4/4)

156 How Cells Work: Energetics, Compartments, and Coupling in Cell Biology (also 256) (4/4)

202 Advanced Immunology II (same as IMMUNOL 202) (3/3) **only appropriate for graduate students

Neurobiology (NBIO)

206 The Nervous System (8/5)

218 Neural Basis of Behavior (5/4)

Neurology & Neurological Sciences (NENS)

220 Computational Neuroscience (4/4)

Overseas Studies - Australia (OSPAUSTL) **graduate students cannot take courses in Overseas Studies; Overseas Studies courses are for undergraduates only.

- 10 Coral Reef Ecosystems (3/2)
- 25 Freshwater Systems (3/2)
- 30 Coastal Forest Ecosystems (3/2)

Overseas Studies - Madrid (OSPMADR) **graduate students cannot take courses in Overseas Studies; Overseas Studies courses are for undergraduates only.

- 73 The Neuroscience of Language Learning (3/2)

Overseas Studies - Paris (OSPPARIS) **graduate students cannot take courses in Overseas Studies; Overseas Studies courses are for undergraduates only.

- 83 The Cancer Problem: Causes, Treatments, and Prevention (4/4)
- 88 Principles of Biochemistry (3/3)

Overseas Studies - Santiago (OSPSANTG) **graduate students cannot take courses in Overseas Studies; Overseas Studies courses are for undergraduates only.

- 27 Humans and the Environment: The Great Transitions (5/3)
- 85 Marine Ecology of Chile and the South Pacific (5/5)

Pathology (PATH)

- 101 Cancer Biology (same as CBIO 101) (4/4)

Philosophy (PHIL)

- 167A Philosophy of Biology (also 267A) (4/4)

Physics (PHYSICS)

- 105 Intermediate Physics Lab I: Analog Electronics (3/3)

Psychology (PSYCH)

- 121 Ion Transport and Intracellular Messengers (also 228) (3/3)
- 202 Cognitive Neuroscience (3/3)
- 221 Applied Vision and Image Systems (3/3)

Radiology (RAD)

- 220 Introduction to Imaging & Image-Based Neuro Anatomy (same as BIOE 220) (3/3)

Statistics (STATS)

- 116 Theory of Probability (5/5)

Structural Biology (SBIO)

- 228 Computational Structural Biology (same as BIOPHYS 228) (3/3)
- 241 Biological Macromolecules (same as BIOC 241, BIOPHYS 241) (5/5)

Surgery (SURG)

- 101 Regional Study of Human Structure (5/5)

Degree Requirements

Candidates for the bachelor's degree in Biology must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted.

1. Core Courses

Three lecture courses:

BIO 41 (Genetics, Biochemistry, and Molecular Biology), BIO 42 (Cell Biology and Animal Physiology), and BIO or BIOHOPK 43 (Plant Biology, Evolution, and Ecology)

Two lab courses:

BIO 44X (Core Molecular Biology Laboratory) and BIO or BIOHOPK 44Y** (Core Plant Biology & Eco-Evo Laboratory)

**Not required if completing honors program. Failure to complete honors program will result in student being required to complete BIO 44Y. NO EXCEPTIONS.

2. Required Foundational Breadth Courses – students may take up to two foundational breadth courses CR/NC

CHEM 31A and 31B or 31X (Chemical Principles)

CHEM 33 or CHEM 1 (Structure and Reactivity)

CHEM 35 or CHEM 2 (Organic Monofunctional Compounds)

CHEM 36* (Organic Chemistry Laboratory I) or CHEM 1L (Introduction to Organic Chemistry Lab) & 2L (Organic Lab 1)

CHEM 130 (Organic Chemistry Laboratory II) or CHEM 2L (Organic Lab 2) & 3L (Organic Lab2) or other approved alternative**

CHEM 131 or CHEM 3 (Organic Polyfunctional Compounds)

CHEM 135 (Physical Chemical Principles) or 171 (Physical Chemistry)

*Not required if CHEM 35 was taken Autumn 2014 or later.

**May be substituted with upper-division, above 100-level quantitative or computational course from this list: BIO 182, 183, 220; BIOC 218; BIOMEDIN 212, 214, 217, 231, 262, 374; CS courses above 106A (may not fulfill both the CHEM 130 and additional foundational breadth requirement); GENE 212, 214, 244; MATH courses above 102; STATS 116.

PHYSICS 21, 22 (Mechanics and Heat with Lab), 23, 24 (Electricity and Optics with Lab) or 41 (Mechanics), 43 (Electricity and Magnetism), 45 (Light and Heat) or 21S (Mechanics and Heat with laboratory), 23S (Electricity and Optics with lab)

MATH 19, 20, 21 (Calculus) or 41, 42 (Calculus) or 51** (Linear Algebra & Differential Calculus of Several Variables)

**can be used for math requirement OR foundational breadth requirement but not both.

Students should refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which math sequence is appropriate.

Additional Foundational Breadth Course - One of the following:

- BIOHOPK 174H* (Experimental Design and Probability)
- BIO/STATS 141* (Biostatistics)
- CS 106A (Programming Methodology) or 106X (Programming Abstractions - Accelerated)
- MATH 51** or beyond (Linear Algebra & Differential Calculus of Several Variables)
- STATS 60 or beyond (Introduction to Statistical Methods: Precalculus)

*can be used for foundational breadth requirement OR electives, but not both.

**can be used for math requirement OR foundational breadth requirement but not both.

3. Electives – students may take up to 6 elective units CR/NC

The elective requirement for the general major must include a total of 24 elective units, distributed as follows:

- Biology or Hopkins Marine Station courses numbered 100 or above (see ExploreCourses)
- Approved out-of-department electives (list available in the Student Services Office or on the department website).
- One course from at least three of the four central menu areas (Area 1 – Molecular; Area 2 – Cell/Developmental; Area 3 – Organismal; Area 4 – Ecology/Evolution). The purpose of the Central Menu is to expose students to the wide range of topics studied within the field of biology, and is intended to give students a breadth of knowledge.
- **Unit Restrictions** – No more than 6 units from any combination of the following courses: BIOHOPK 199H, BIO 196ABC, 197WA, 198/X, 199/X/W, 290, or 291) may be applied toward the total number of elective units.

4. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

5. Honors Requirements (if applicable)

Students who have applied for and been accepted into the departmental honors program must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

- A. Approved honors petition
- B. 10 units of BIO 199/X or BIOHOPK 199H from the same lab (up to 6 of these units may be applied toward Electives)
- C. Poster/Oral Presentation
- D. Honors Thesis

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Biochemistry and Biophysics must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Biochemistry and Biophysics field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

BIO 41 – Genetics, Biochemistry, and Molecular Biology, BIO 42 – Cell Biology and Animal Physiology, and
BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

BIO 44X (Core Molecular Biology Laboratory)

2. Required Foundational Breadth Courses – Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and B (or 31X), 33 (or 1), 35 (or 2), 36* (or 1L and 2L), 130 (or 2L and 3L), 135 (or 171)

PHYSICS 41, 43, 45

MATH 51, 52

STATS 60 or BIO 141**

*Not required if CHEM 35 was taken Autumn 2014 or later.

**May only fulfill one requirement. Students can use for foundational breadth OR elective credit.

3. Required Biology Courses

BIO 104 – Advanced Molecular Biology

BIO 118 – Genetic Analysis of Biological Processes

BIO 188 – Biochemistry I

BIO 123A – Cell and Developmental Biology I **OR** BIO 123B – Cell and Developmental Biology II **OR** BIO 129B – Cellular Dynamics II: Building a Cell **OR** (prior to 2015-16): BIO 129A – Cellular Dynamics I: Cell Motility and Adhesion

4. Three courses from a list of approved courses in the area of Biochemistry and Biophysics.

Current list of approved courses in the area of Biochemistry and Biophysics:

APPPHYS 236/BIOC 236 – Biology by the Numbers

APPPHYS 293- Theoretical Neuroscience

APPHYS 294- Cellular Biophysics

BIO 132/232/BIOPHYS/APPPHYS/MCP 232 – Advanced Imaging Lab in Biophysics

BIO 152/MCP 222 – Imaging: Biological Light Microscopy

BIO 154 – Molecular and Cellular Neurobiology

BIO 189/CHEM 183/CHEMENG 183/283 – Biochemistry II

BIO 214/BIOC 224 – Advanced Cell Biology

BIO 217 – Neuronal Biophysics

BIOE 101- Systems Biology

BIOE 103- Systems Physiology and Design

BIOE/RAD 220 – Introduction to Imaging & Image-based Neuro Anatomy

BIOMEDIN 210 – Modeling Biomedical Systems: Ontology, Terminology, Problem Solving

BIOMEDIN/BIOE/GENE 214/CS 274 – Representations & Algorithms for Computational Molecular Biology

BIOMEDIN 231/BIOC 218 – Computational Molecular Biology

BIOPHYS/SBIO 228 – Computational Structural Biology

BIOPHYS/SBIO 241 – Biological Macromolecules

CHEM 184 – Biological Chemistry Laboratory

CHEM 185 – Biochemistry III

EE 236A –Modern Optics

MCP 256 – How Cells Work: Energetics, Compartments, and Coupling in Cell Biology

PHYSICS 105 – Intermediate Physics Lab I: Analog Electronics

5. Biology Electives – Students may take one of these courses with the CR/NC grading option.

Electives must include 7 units of 100-level or above courses offered in the Department of Biology, Hopkins Marine Station, or from the list of approved out-of-department electives. No more than 6 units from any combination of the following courses: BIO 196ABC, 197WA, 198/X, 199/W/X, 290, 291, BIOHOPK 199H may be applied toward the total number of Biology elective units.

6. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

7. Research and Honors Requirements

Students in the Biochemistry and Biophysics field of study must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from the same lab (up to 6 of these units may be applied toward Biology Electives)

C. Poster/Oral Presentation

D. Honors Thesis

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Computational Biology must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Computational Biology field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

- BIO 41 – Genetics, Biochemistry, and Molecular Biology
- BIO 42 – Cell Biology and Animal Physiology
- BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

- BIO 44X (Core Molecular Biology Laboratory) or
- BIO/BIOHOPK 44Y (Core Plant Biology & Eco Evo Laboratory)

2. Required Foundational Breadth Courses

Students may take up to two of the Group 1 courses with the CR/NC grading option.

Group 1

- CHEM 31A and 31B (or 31X), 33 (or 1), 35 (or 2), 36* (or 1L and 2L)
 - PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S
- *Not required if CHEM 35 was taken Autumn 2014 or later.

Group 2

- MATH 51 – Linear Algebra and Differential Equations of Several Variables
- CS 106A – Programming Methodology
- BIO 141/STATS 141 – Biostatistics

3. Four courses from this list of courses with computational emphasis in biology and related subjects:

- BIO 126 – Introduction to Biophysics
- BIO 182 – Modeling Cultural Evolution
- BIO183 – Theoretical Population Genetics
- BIO 202 – Ecological Statistics
- BIO 268 Statistical and Machine Learning Methods for Genomics
- BIOE 101 – Systems Biology
- BIOE 115 – Computational Modeling of Microbial Communities
- BIOPHYS 228 – Computational Structural Biology
- STATS 155 – Statistical Methods in Computational Genetics

4. Biology Electives – Students may take one of these courses with the CR/NC grading option.

Elective units must include **three** 100-level or above courses (of 3 units or more) offered in the Department of Biology, Hopkins Marine Station, Department of Computer Sciences or from the list of approved out-of-department electives. Research and teaching units may not count towards this requirement.

5. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

6. Research and Honors Requirements

Students in the Computational Biology field of study must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

- A. Approved honors proposal
- B. 10 units of BIO 199/X or BIOHOPK 199H from the same lab (may not also count toward elective units)
- C. Poster/Oral Presentation
- D. Honors Thesis

<p>CORE COURSES: Lecture courses letter-grade only</p>	<p>4 lecture courses: <input type="checkbox"/> BIO 41 <input type="checkbox"/> BIO 42 <input type="checkbox"/> BIO/BIOHOPK 43 1 lab course: <input type="checkbox"/> BIO 44X or <input type="checkbox"/> BIO/BIOHOPK 44Y</p>					
<p>REQUIRED FOUNDATIONAL BREADTH COURSES, GROUP 1: Students may take up to two courses with the CR/NC grading option.</p>	<p>CHEMISTRY <input type="checkbox"/> 31A and <input type="checkbox"/> 31B or <input type="checkbox"/> 31X <input type="checkbox"/> 33 or <input type="checkbox"/> 1 <input type="checkbox"/> 35 or <input type="checkbox"/> 2 <input type="checkbox"/> 36* or <input type="checkbox"/> 1L and <input type="checkbox"/> 2L *Not required if Chem 35 was taken Autumn 2014 or later</p>					
	<p>PHYSICS <input type="checkbox"/> 21 <input type="checkbox"/> 22 <input type="checkbox"/> 23 <input type="checkbox"/> 24 or <input type="checkbox"/> 41 <input type="checkbox"/> 43 <input type="checkbox"/> 45 or <input type="checkbox"/> 21S <input type="checkbox"/> 23S</p>					
<p>REQUIRED ADDITIONAL FOUNDATIONAL BREADTH COURSES, GROUP 2: All courses must be taken for a letter-grade only.</p>	<p><input type="checkbox"/> MATH 51 <input type="checkbox"/> CS 106A <input type="checkbox"/> BIO/STATS 141</p>					
<p>REQUIRED COMPUTATIONAL BIOLOGY COURSES: Students must take <u>four</u> of these courses. Letter-grade only.</p>	<p><input type="checkbox"/> BIO 126 <input type="checkbox"/> BIOE 101 <input type="checkbox"/> BIO 182 <input type="checkbox"/> BIOE 115 <input type="checkbox"/> BIO 183 <input type="checkbox"/> BIOPHYS 228 <input type="checkbox"/> BIO 202 <input type="checkbox"/> STATS 155 <input type="checkbox"/> BIO 268</p>					
<p>ELECTIVES: Three courses of 3 or more units each. Research/teaching units (e.g. BIO 196-199) may not count toward this requirement. One course may be taken CR/NC. See guidelines on reverse side for more information.</p>	BIO ELECTIVES	UNITS	CS ELECTIVES	UNITS	OUT-OF-DEPT	UNITS
<p>WRITING IN THE MAJOR: One course. May overlap with other requirements.</p>	<p>BIO <input type="checkbox"/> 107 <input type="checkbox"/> 137 <input type="checkbox"/> 168 <input type="checkbox"/> 196A <input type="checkbox"/> 197WA <input type="checkbox"/> 199W starting 2014-15 <input type="checkbox"/> 44Y BIOHOPK <input type="checkbox"/> 44Y <input type="checkbox"/> 172H</p>					
<p>RESEARCH & HONORS REQUIREMENTS:</p>	<p><input type="checkbox"/> 10 Units of BIO 199/X or BIOHOPK 199H <input type="checkbox"/> 199X petition on file, if applicable <input type="checkbox"/> Poster/Oral Presentation <input type="checkbox"/> Honors Thesis</p>					

Name: _____ Email: _____ SU ID#: _____ Date: _____

<p>Unfinished Requirements:</p>

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Ecology and Evolution must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Ecology and Evolution field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Four lecture courses:

BIO 41 – Genetics, Biochemistry, and Molecular Biology, BIO 42 – Cell Biology and Animal Physiology, and BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

BIO 101 – Ecology* **OR** BIOHOPK 172H/272H – Marine Ecology*

* Please note that this course cannot also count toward the requirement outlined in section 4 below

One lab course:

BIO 44X (Core Molecular Biology Laboratory) or BIO/BIOHOPK 44Y (Core Plant Biology & Eco Evo Laboratory)

2. Required Foundational Breadth Courses – Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and 31B (or 31X), 33 (or 1), 35 (or 2), 36* (or 1L and 2L)

PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S

MATH 19, 20, 21; or 41, 42; or 51 (refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which is appropriate.)

* Not required if CHEM 35 was taken Autumn 2014 or later.

3. Required Biology Courses

One course from each of the following two categories. None of these courses may count in both sections 3 and 4 if taken to satisfy this requirement. If more than one course is taken, the extra course(s) can be used toward the 30 units of electives in section 4 (below).

Category 1: Evolution

BIO 113 – Fundamentals of Molecular Evolution

BIO 136 – Evolutionary Paleobiology

BIO 143 – Evolution

BIOHOPK 166H – Molecular Ecology

Category 2: Quantitative Methods

STATS 60/PSYCH 10 – Introduction to Statistical Methods

BIO 141 – Biostatistics

BIOHOPK 174H – Experimental Design & Probability

CS 106A or X – Programming Methodology

4. Electives – Students may take one of these courses with the CR/NC grading option.

Elective units must include 30 units from this approved list (or others by petition):

BIO 101¹, 105A, 105B, 116, 117, 118, 121, 122, 131, 139, 144, 145, 146, 182, 183, 227, 234, 274S

BIOHOPK 161H, 162H, 163H, 166H, 172H¹, 173H*, 174H², 182H***, 184H***, 185H***, 187H, 264H, 268H, 275H

CHEM 130, 131

EARTHSYS 128, 144, 158

EESS 158

GS 128

OSPAUSTL 010**, 025**, 030**

*1 unit only; **2 units only; ***6 units only

¹ Cannot also count toward core course requirement

² Cannot also count toward quantitative methods requirement

No more than one CR/NC course may be used to fulfill this requirement.

5. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

6. Research and Honors Requirements

Students in the Ecology and Evolution field of study must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from the same lab

C. Poster/Oral Presentation

D. Honors Thesis

<p>CORE COURSES: Lecture courses letter-grade only</p>	<p>4 lecture courses: <input type="checkbox"/> BIO 41 <input type="checkbox"/> BIO 42 <input type="checkbox"/> BIO/BIOHOPK 43 <input type="checkbox"/> BIO 101* or <input type="checkbox"/> BIOHOPK 172H* 1 lab course: <input type="checkbox"/> BIO 44X or <input type="checkbox"/> BIO/BIOHOPK 44Y</p> <p><small>*This course cannot also count toward the elective requirement</small></p>																		
<p>REQUIRED FOUNDATIONAL BREADTH COURSES: Students may take up to two foundational breadth courses with the CR/NC grading option.</p>	<p>CHEMISTRY</p> <p><input type="checkbox"/> 31A & <input type="checkbox"/> 31B or <input type="checkbox"/> 31X <input type="checkbox"/> 33 or <input type="checkbox"/> 1 <input type="checkbox"/> 35 or <input type="checkbox"/> 2 <input type="checkbox"/> 36* or <input type="checkbox"/> 1L and <input type="checkbox"/> 2L <small>*Not required if Chem 35 was taken Autumn 2014 or later</small></p>																		
	<p>PHYSICS</p> <p><input type="checkbox"/> 21 <input type="checkbox"/> 22 <input type="checkbox"/> 23 <input type="checkbox"/> 24 or <input type="checkbox"/> 41 <input type="checkbox"/> 43 <input type="checkbox"/> 45 or <input type="checkbox"/> 21S <input type="checkbox"/> 23S</p>																		
	<p>MATH</p> <p><input type="checkbox"/> 19 <input type="checkbox"/> 20 <input type="checkbox"/> 21 or <input type="checkbox"/> 41 <input type="checkbox"/> 42 or <input type="checkbox"/> 51</p>																		
<p>REQUIRED BIOLOGY COURSES: Students must take one course category 1, and one course category 2. None of these courses can count as Electives below if taken to satisfy this requirement. If more than one course is taken from each area, the extra course(s) can be used toward the 30 units of electives. Letter-grade only.</p>	<table style="width:100%; border-collapse: collapse;"> <tr> <td style="width:50%; border-right: 1px solid black; vertical-align: top;"> <p><u>Category 1: Evolution</u></p> <p><input type="checkbox"/> BIO 113 <input type="checkbox"/> BIO 136 <input type="checkbox"/> BIO 143 <input type="checkbox"/> BIOHOPK 166H</p> </td> <td style="width:50%; vertical-align: top;"> <p><u>Category 2: Quantitative Methods</u></p> <p><input type="checkbox"/> BIO/STATS 141 <input type="checkbox"/> STATS 60 or beyond <input type="checkbox"/> CS 106A or X <input type="checkbox"/> BIOHOPK 174H</p> </td> </tr> </table>	<p><u>Category 1: Evolution</u></p> <p><input type="checkbox"/> BIO 113 <input type="checkbox"/> BIO 136 <input type="checkbox"/> BIO 143 <input type="checkbox"/> BIOHOPK 166H</p>	<p><u>Category 2: Quantitative Methods</u></p> <p><input type="checkbox"/> BIO/STATS 141 <input type="checkbox"/> STATS 60 or beyond <input type="checkbox"/> CS 106A or X <input type="checkbox"/> BIOHOPK 174H</p>																
<p><u>Category 1: Evolution</u></p> <p><input type="checkbox"/> BIO 113 <input type="checkbox"/> BIO 136 <input type="checkbox"/> BIO 143 <input type="checkbox"/> BIOHOPK 166H</p>	<p><u>Category 2: Quantitative Methods</u></p> <p><input type="checkbox"/> BIO/STATS 141 <input type="checkbox"/> STATS 60 or beyond <input type="checkbox"/> CS 106A or X <input type="checkbox"/> BIOHOPK 174H</p>																		
<p>ELECTIVES: Students must take 30 units of approved Ecology/Evolution Electives, or other courses by petition. One course may be taken CR/NC. See reverse for more information.</p> <p>_____ units completed (30 required)</p>	<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width:16.6%;">COURSE</th> <th style="width:16.6%;">UNITS</th> <th style="width:16.6%;">COURSE</th> <th style="width:16.6%;">UNITS</th> <th style="width:16.6%;">COURSE</th> <th style="width:16.6%;">UNITS</th> </tr> </thead> <tbody> <tr> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> <td> </td> </tr> <tr> <td colspan="2" style="text-align: center;">Total Units</td> <td colspan="2" style="text-align: center;">Total Units</td> <td colspan="2" style="text-align: center;">Total Units</td> </tr> </tbody> </table>	COURSE	UNITS	COURSE	UNITS	COURSE	UNITS							Total Units		Total Units		Total Units	
COURSE	UNITS	COURSE	UNITS	COURSE	UNITS														
Total Units		Total Units		Total Units															
<p>WRITING IN THE MAJOR: One course. May overlap with other requirements.</p>	<p>BIO <input type="checkbox"/> 107 <input type="checkbox"/> 137 <input type="checkbox"/> 168 <input type="checkbox"/> 196A <input type="checkbox"/> 197WA <input type="checkbox"/> 199W starting 2014-15 <input type="checkbox"/> 44Y BIOHOPK <input type="checkbox"/> 44Y <input type="checkbox"/> 172H</p>																		
<p>RESEARCH & HONORS REQUIREMENTS:</p>	<p><input type="checkbox"/> 10 Units of BIO 199/X or BIOHOPK 199H <input type="checkbox"/> 199X petition on file, if applicable <input type="checkbox"/> Poster/Oral Presentation <input type="checkbox"/> Honors Thesis</p>																		

Name: _____ Email: _____ SU ID#: _____ Date: _____

<p>Unfinished Requirements:</p>

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Marine Biology must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Marine Biology field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

BIO 41 – Genetics, Biochemistry, and Molecular Biology, BIO 42 – Cell Biology and Animal Physiology, and BIO/BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

BIO 44X (Core Molecular Biology Laboratory) **or** BIO/BIOHOPK 44Y (Core Plant Biology & Eco Evo Laboratory)

2. Required Foundational Breadth Courses - Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and 31B (or 31X), 33(or 1), 35(or 2), 36* (or 1L and 2L), 130 (or 2L and 3L or other approved alternative**), 131 (or 3) PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S

MATH 19, 20, 21; or 41, 42; or 51 (refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which is appropriate.)

STATS 60, BIO 141, or BIOHOPK 174H

* Not required if CHEM 35 was taken Autumn 2014 or later.

**May be substituted with upper-division, above 100-level quantitative or computational course from this list: BIO 182, 183, 220; BIOC 218; BIOMEDIN 212, 214, 217, 231, 262, 374; CS courses above 106A (may not fulfill both the CHEM 130 and additional foundational breadth requirement); GENE 212, 214, 244; MATH courses above 102; STATS 116.

3. Required Biology Courses

BIO 101 – Ecology **or** BIOHOPK 172H – Marine Ecology*

BIO 118 – Genetic Analysis of Biological Processes

BIO 143 – Evolution

*Please note that this course cannot also count in section 4 below.

4. Four of the following:

BIO/EARTHSYS 116 – Ecology of the Hawaiian Islands

BIOHOPK 150H – Ecological Mechanics

BIOHOPK 155H – Developmental Biology and Evolution

BIOHOPK 160H – Developmental Biology in the Ocean

BIOHOPK 161H – Invertebrate Zoology

BIOHOPK 162H – Comparative Animal Physiology

BIOHOPK 163H – Oceanic Biology

BIOHOPK 167H – Nerve, Muscle, and Synapse

BIOHOPK 172H – Marine Ecology*

BIOHOPK 173H – Marine Conservation Biology

BIOHOPK 177H – Dynamics and Management of Marine Populations

BIOHOPK 179H – Physiological Ecology of Marine Megafauna

BIOHOPK 182H – Stanford at Sea

BIOHOPK 185H – Ecology and Conservation of Kelp Forest Communities

BIOHOPK 187H – Sensory Ecology

OSPAUSTL 10, 25, and 30 – Coral Reef Ecosystems, Freshwater Systems and Coastal Forest Ecosystems**

*This course cannot also count in section 3 above.

**These three courses as a whole count as one of the four required courses in this section.

5. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

6. Research and Honors Requirements

Students in the Marine Biology field of study must fulfill the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from the same lab

C. Poster/Oral Presentation

D. Honors Thesis on a marine biology topic. One Hopkins Marine Station faculty member must be a reader on the thesis.

<p>CORE COURSES: Lecture courses letter-grade only</p>	<p>3 lecture courses: <input type="checkbox"/> BIO 41 <input type="checkbox"/> BIO 42 <input type="checkbox"/> BIO/BIOHOPK 43 1 lab course: <input type="checkbox"/> BIO 44X or <input type="checkbox"/> BIO/BIOHOPK 44Y</p>																
<p>REQUIRED FOUNDATIONAL BREADTH COURSES: Students may take up to two foundational breadth courses with the CR/NC grading option.</p>	<p>CHEMISTRY <input type="checkbox"/> 31A & <input type="checkbox"/> 31B or <input type="checkbox"/> 31X <input type="checkbox"/> 33 or <input type="checkbox"/> 1 <input type="checkbox"/> 35 or <input type="checkbox"/> 2 <input type="checkbox"/> 36* or <input type="checkbox"/> 1L & <input type="checkbox"/> 2L <input type="checkbox"/> 130 or <input type="checkbox"/> 2L and <input type="checkbox"/> 3L or <input type="checkbox"/> other approved alternative <input type="checkbox"/> 131 or <input type="checkbox"/> 3</p> <p><small>*Not required if Chem 35 was taken Autumn 2014 or later</small></p> <p>PHYSICS <input type="checkbox"/> 21 <input type="checkbox"/> 22 <input type="checkbox"/> 23 <input type="checkbox"/> 24 or <input type="checkbox"/> 41 <input type="checkbox"/> 43 <input type="checkbox"/> 45 or <input type="checkbox"/> 21S <input type="checkbox"/> 23S</p> <p>MATH <input type="checkbox"/> 19 <input type="checkbox"/> 20 <input type="checkbox"/> 21 or <input type="checkbox"/> 41 <input type="checkbox"/> 42 or <input type="checkbox"/> 51</p> <p>ADDITIONAL FOUNDATIONAL BREADTH <input type="checkbox"/> BIO 141 or <input type="checkbox"/> STATS 60 or <input type="checkbox"/> BIOHOPK 174H</p>																
<p>REQUIRED BIOLOGY COURSES: Letter-grade only</p>	<p><input type="checkbox"/> BIO 101 or <input type="checkbox"/> BIOHOPK 172H* <input type="checkbox"/> BIO 118 <input type="checkbox"/> BIO 143</p> <p><small>*if taken for this requirement, cannot also count below.</small></p>																
<p>REQUIRED MARINE BIOLOGY COURSES: Letter-grade only</p>	<p>Students must take <u>four</u> of these courses.</p> <table border="0"> <tr> <td><input type="checkbox"/> BIO/EARTHSYS 116</td> <td><input type="checkbox"/> BIOHOPK 172H*</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 150H</td> <td><input type="checkbox"/> BIOHOPK 173H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 155H</td> <td><input type="checkbox"/> BIOHOPK 177H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 160H</td> <td><input type="checkbox"/> BIOHOPK 179H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 161H</td> <td><input type="checkbox"/> BIOHOPK 182H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 162H</td> <td><input type="checkbox"/> BIOHOPK 185H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 163H</td> <td><input type="checkbox"/> BIOHOPK 187H</td> </tr> <tr> <td><input type="checkbox"/> BIOHOPK 167H</td> <td><input type="checkbox"/> OSPAUSTL 10, 25 and 30 (must take all 3)</td> </tr> </table> <p><small>*May not also count above</small></p>	<input type="checkbox"/> BIO/EARTHSYS 116	<input type="checkbox"/> BIOHOPK 172H*	<input type="checkbox"/> BIOHOPK 150H	<input type="checkbox"/> BIOHOPK 173H	<input type="checkbox"/> BIOHOPK 155H	<input type="checkbox"/> BIOHOPK 177H	<input type="checkbox"/> BIOHOPK 160H	<input type="checkbox"/> BIOHOPK 179H	<input type="checkbox"/> BIOHOPK 161H	<input type="checkbox"/> BIOHOPK 182H	<input type="checkbox"/> BIOHOPK 162H	<input type="checkbox"/> BIOHOPK 185H	<input type="checkbox"/> BIOHOPK 163H	<input type="checkbox"/> BIOHOPK 187H	<input type="checkbox"/> BIOHOPK 167H	<input type="checkbox"/> OSPAUSTL 10, 25 and 30 (must take all 3)
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<input type="checkbox"/> BIOHOPK 167H	<input type="checkbox"/> OSPAUSTL 10, 25 and 30 (must take all 3)																
<p>WRITING IN THE MAJOR: One course. May overlap with other requirements.</p>	<p>BIO <input type="checkbox"/> 107 <input type="checkbox"/> 137 <input type="checkbox"/> 168 <input type="checkbox"/> 196A <input type="checkbox"/> 197WA <input type="checkbox"/> 199W starting 2014-15 <input type="checkbox"/> 44Y BIOHOPK <input type="checkbox"/> 44Y <input type="checkbox"/> 172H</p>																
<p>RESEARCH & HONORS REQUIREMENTS:</p>	<p><input type="checkbox"/> 10 Units of BIO 199/X or BIOHOPK 199H <input type="checkbox"/> 199X petition on file, if applicable <input type="checkbox"/> Poster/Oral Presentation <input type="checkbox"/> Honors Thesis on a Marine Biology topic</p>																

Name: _____ Email: _____ SU ID#: _____ Date: _____

Unfinished Requirements:

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Microbes and Immunity must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Microbes and Immunity field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

BIO 41 – Genetics, Biochemistry, and Molecular Biology, BIO 42 – Cell Biology and Animal Physiology, and
BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

BIO 44X (Core Molecular Biology Laboratory) or BIO/BIOHOPK 44Y (Core Plant Biology & Eco Evo Laboratory)

2. Required Foundational Breadth Courses – Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and 31B (or 31X), 33(or 1), 35 (or 2), 36* (or 1L and 2L), 130 (or 2L and 3L or other approved alternative)**, 131 or (3)
PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S

MATH 19, 20, 21; or 41, 42; or 51 (refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which is appropriate.)

BIO 141*** or BIOHOPK 174H***

* Not required if CHEM 35 was taken Autumn 2014 or later

**May be substituted with upper-division, above 100-level quantitative or computational course from this list: BIO 182, 183, 220; BIOC 218; BIOMEDIN 212, 214, 217, 231, 262, 374; CS courses above 106A (may not fulfill both the CHEM 130 and additional foundational breadth requirement); GENE 212, 214, 244; MATH courses above 102; STATS 116.

***Please note that this course cannot also count towards the elective requirement

3. Four Courses in Microbiology, Immunology, Molecular Evolution

BIO 177 – Plant Microbe Interaction

BIO 230 – Molecular & Cellular Immunology

BIO 232- Advanced Imaging Lab

BIOHOPK 274 – Hopkins Microbiology

CEE 177 – Aquatic Chemistry & Biology

CEE 274A – Environmental Microbiology I

CEE 274B – Metabolic Biochemistry of Microorganisms

CEE 274D – Pathogenesis & Disinfection

EARTHSYS 158- Geomicrobiology

HUMBIO 152- Viral Lifecycles

HUMBIO 155H/MI 155H- Humans and Viruses I

IMMUNOL 201- Advanced Immunology I

IMMUNOL 202 – Advanced Immunology II

IMMUNOL 209- Translational Immunology

IMMUNOL 260- HIV: the Virus, the Disease, the Research

IMMUNOL 275- Tumor Immunology

MI 104 – Innate Immunity

MI 120- Bacteria in Health and Disease

MI 209- Adv. Pathogenesis of Bacteria, Viruses, and Parasites I

MI 210- Adv. Pathogenesis of Bacteria, Viruses, and Parasites II

MI 211 – Advanced Immunology I

4. One Course in Reading Scientific Literature

Select one of the following or students may petition for other courses in reading scientific literature:

BIO 178 – Microbiology Literature

MI 185 – Topics in Microbiology

5. Electives – Students may take one of these courses with the CR/NC grading option.

Electives must include 12 units of 100-level or above courses offered in the Department of Biology, Hopkins Marine Station, or from the list of approved out-of-department electives. No more than 6 units from any combination of the following courses: BIO 196ABC, 197WA, 198/X, 199/W/X, 290, 291, BIOHOPK 199H) may be applied toward the total number of Biology elective units.

6. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements

7. Research and Honors Requirements

Students in the Microbes and Immunity field of study must fulfill the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from same lab (up to 6 of these units may be applied toward Biology Electives)

C. Poster/Oral Presentation

D. Honors Thesis

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Molecular and Cell Biology must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Molecular, Cellular, and Developmental Biology field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

- BIO 41 – Genetics, Biochemistry, and Molecular Biology,
- BIO 42 – Cell Biology and Animal Physiology, and
- BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

- BIO 44X (Core Molecular Biology Laboratory) or BIO/BIOHOPK 44Y (Core Plant Biology & Eco Evo Laboratory)

2. Required Foundational Breadth Courses – Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and 31B (or 31X), 33 (or 1), 35 (or 2), 36* (or 1L and 2L), 130 (or 2L and 3L or other approved alternative)**, 131 (or 3), 135 (or 171)

PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S

MATH 19, 20, 21; or 41, 42; or 51 (refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which is appropriate).

STATS 60 or BIO 141***

*Not required if CHEM 35 was taken Autumn 2014 or later.

**May be substituted with upper-division, above 100-level quantitative or computational course from this list: BIO 182, 183, 220; BIOC 218; BIOMEDIN 212, 214, 217, 231, 262, 374; CS courses above 106A (may not fulfill both the CHEM 130 and additional foundational breadth requirement); GENE 212, 214, 244; MATH courses above 102; STATS 116.

***This course cannot also count towards the elective requirement

3. Four Required Biology Courses

A. BIO 104 – Advanced Molecular Biology

B. BIO 118 – Genetic Analysis of Biological Processes

C. Please select 2 of the following courses:

- BIO 123A – Cell and Developmental Biology I: Cell and Tissue Organization
- BIO 123B – Cell and Developmental Biology II: Dynamics and Networks
- BIO 129B – Cellular Dynamics II
- BIO 129A - Cellular Dynamics I (prior to 2015-16)
- BIO 160A - Developmental Biology I (prior to 2015-16)
- BIO 160B – Developmental Biology II (prior to 2015-16)

4. Electives – Students may take one of these courses with the CR/NC grading option.

Electives must include 15 units of 100-level or above courses offered in the Department of Biology, Hopkins Marine Station, or from the list of approved out-of-department electives. No more than 6 units from any combination of the following courses: BIO 196ABC, 197WA, 198/X, 199/W/X, 290, or 291; BIOHOPK 175H, 199H may be applied toward the total number of Biology elective units.

5. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

6. Research and Honors Requirements

Students in the Molecular and Cell Biology field of study must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from same lab (up to 6 of these units may be applied toward Biology Electives)

C. Poster/Oral Presentation

D. Honors Thesis

Degree Requirements

Candidates for the degree in Biology with a specialized field of study in Neurobiology must complete the following requirements. All courses must be taken for a letter grade unless otherwise noted. The Neurobiology field of study will be noted in the program section of the student's transcript and on the diploma.

1. Core Courses

Three lecture courses:

BIO 41 – Genetics, Biochemistry, and Molecular Biology, BIO 42 – Cell Biology and Animal Physiology, and BIO or BIOHOPK 43 – Plant Biology, Evolution, and Ecology

One lab course:

BIO 44X - Core Molecular Biology Laboratory or BIO/BIOHOPK 44Y - Core Plant Biology & Eco Evo Laboratory

2. Required Foundational Breadth Courses – Students may take up to two of these courses with the CR/NC grading option.

CHEM 31A and B (or 31X), 33 (or 1), 35 (or 2), 36* (or 1L and 2L), 130 (or 2L and 3L or other approved alternative)**, 131(or 3) PHYSICS 21, 22, 23, 24; or 41, 43, 45; or 21S, 23S

MATH 19, 20, 21; or 41, 42; or 51 (refer to <http://math.stanford.edu/undergrad/whatcourse.html> to determine which is appropriate.)

STATS 60 or BIO 141***

* Not required if CHEM 35 was taken Autumn 2014 or later

**May be substituted with upper-division, above 100-level quantitative or computational course from this list: BIO 182, 183, 220; BIOC 218; BIOMEDIN 212, 214, 217, 231, 262, 374; CS courses above 106A (may not fulfill both the CHEM 130 and additional foundational breadth requirement); GENE 212, 214, 244; MATH courses above 102; STATS 116.

***This course cannot also count towards the elective requirement.

3. Required Biology Courses

A. BIO 104 – Advanced Molecular Biology **OR** BIO 118 – Genetic Analysis of Biological Processes

B. BIO 123A – Cell and Developmental Biology I: Cell and Tissue Organization **OR** BIO 123B – Cell and Developmental Biology II: Dynamics and Networks **OR** BIO 129B – Cellular Dynamics II **OR**, Prior to 2015-16: BIO 129A - Cellular Dynamics I **OR** BIO 160A - Developmental Biology I **OR** BIO 160B – Developmental Biology II

C. BIO 150 – Human Behavioral Biology **OR** BIO 163 – Neural Systems & Behavior **OR** BIO 149 - The Neurobiology of Sleep **OR** NBIO 206 - The Nervous System (if taken for 8 units can fulfill both C & D)

D. BIO 154 – Molecular and Cellular Neurobiology **OR** NBIO 206 - The Nervous System (if taken for 8 units can fulfill both C & D)

E. BIO 158 – Developmental Neurobiology

4. Electives – Students may take one of these courses with the CR/NC grading option.

Electives must include 12 units of 100-level or above courses offered in the Department of Biology, Hopkins Marine Station, or from the list of approved out-of-department electives. No more than 6 units from any combination of the following courses: BIO 196ABC, 197WA, 198/X, 199/W/X, 290, or 291; BIOHOPK 175H, 199H may be applied toward the total number of Biology elective units.

5. Writing in the Major – One of the following: BIO 44Y, 107, 137, 168, 196A, 197WA, 199W, BIOHOPK 44Y, 172H. May overlap with other requirements.

6. Research and Honors Requirements

Students in the Neurobiology field of study must fulfill the equivalent of the requirements for graduation with honors in Biology. Following are the requirements:

A. Approved honors proposal

B. 10 units of BIO 199/X or BIOHOPK 199H from same lab (6 of these units may be applied toward Biology Electives)

C. Poster/Oral Presentation

D. Honors Thesis

